

V.3.3-SNOW-43 NWS-43 SNOW MODEL OPERATION

Identifier: SNOW-43

Application: All programs

Description: This Operation is a state-space version of the SNOW-17 snow accumulation and ablation model with the option of performing Kalman filtering updating.

The Kalman filter accounts for the relative uncertainties of observed and simulated water-equivalent values in a procedure that optimally updates the model simulated states using areal estimates of snow-water-equivalent based on observations.

A complete description of the model is in Chapter II.2.

Developed by: Jay Day, Riverside Technology Inc.

Allowable Data Time Intervals: 1, 2, 3, 4, 6, 8, 12 and 24 hours

Time Series Used: Time series used in this Operation are as follows:

<u>General Type</u>	<u>Dimn</u>	<u>Units</u>	<u>Use</u>	<u>Required</u>	<u>Form of Output T.S.</u>	<u>Data Time Interval</u>	<u>Missing Values Allowed</u>
Precipitation	L	MM	I	yes	n/a	any	no
Air temperature	TEMP	DEGC	I	yes	n/a	any <u>1/</u>	no
Rain plus melt	L	MM	O	no	replaces	any <u>2/</u>	no
Percent snowfall	DLES	PCTD	I	no	n/a	any <u>2/</u>	yes
Rain-snow elevation	L	MM	I	no	n/a	any <u>4/</u>	no
Observed water-equivalent	L	MM	I	no	n/a	any <u>3/</u>	yes
Observed water-equivalent variance	L2	MM <u>2/</u>	I	no	n/a	any <u>5/</u>	yes
Simulated water-equivalent	L	MM	O	no	replaces	any <u>3/</u>	yes
Simulated water-equivalent	L2	MM <u>2/</u>	O	no	replaces	any <u>5/</u>	yes

General Type	Dimn	Units	Use	Required	Form of Output T.S.	Data Time Interval	Missing Values Allowed
--------------	------	-------	-----	----------	---------------------	--------------------	------------------------

variance

Observed areal snow cover	DLES	PCTD	I	no	n/a	any <u>3</u> /	yes
Simulated areal snow cover	DLES	PCTD	O	no	replaces	any <u>3</u> /	no

1/ Must be an even multiple of the data time interval for precipitation data.

2/ Must be the same as the data time interval for precipitation data.

3/ Must be an even multiple of the data time interval for air temperature data.

4/ Must be the same as the data time interval for temperature data.

5/ Must be the same as the data time interval for the water-equivalent data.

Input Summary: The card input for this Operation is as follows:

<u>Card</u>	<u>Format</u>	<u>Columns</u>	<u>Contents</u>
1	5A4	1-20	Header information (e.g. name of the area or point)
	F5.0	21-25	Elevation of the area or point (units of M)
	F5.0	26-30	Latitude of the area or point in degrees; if greater than or equal to 54.0 the Alaskan seasonal melt-factor variation is used
	1XA4	32-35	Printer output control: 'ALL ' = output for all days 'NONE' = no output during execution Default is output on all significant days which are days when: <ul style="list-style-type: none"> o snow first appears o snow disappears o snowfall or rain-on-snow exceeds 5 MM o surface energy exchange exceeds 5 MM o observed data are available Also on the last day of observed data and last day of the execution period

<u>Card</u>	<u>Format</u>	<u>Columns</u>	<u>Contents</u>
	2X,A3	38-40	Observed time series indicator; default is no observed time series used; enter 'YES' if observed water-equivalent or areal snow cover time series are used
	2X,A3	43-45	Simulated time series indicator; default is no simulated time series produced; enter 'YES' if the Operation should generate simulated water-equivalent or areal snow cover time series
	1X,A4	47-50	Option to store sums of snow cover water balance variables; default is sums not stored; enter 'SUMS' to store water balance variables.
	4X,A4,A2	55-60	Update option (only used for Calibration System programs); default is no updating; enter 'UPDATE' to update water-equivalent and areal snow cover when observed values are available
	1X,A4	62-65	Read carryover option; default is to set carryover values to indicate no snow cover exists; enter 'RDCO' to input initial snow conditions
	1X,A4	67-70	Rain-snow elevation option; default is to not use rain-snow elevation data; enter 'AVSE' to use an areal versus elevation curve and a rain-snow elevation time series to determine the form of precipitation
	1X,A4	71-75	Kalman filtering updating indicator. Default is not to use Kalman filtering updating; enter 'PROP' to propagate the state-space error covariance matrix (P) and use Kalman filtering updating.
2	3X,I2	4-5	Data time interval in hours for precipitation, rain plus melt and percent snowfall time series; default is 6
	2X,2A4	8-15	Identifier of precipitation time series
	1X,A4	17-20	Data type code of precipitation time series

<u>Card</u>	<u>Format</u>	<u>Columns</u>	<u>Contents</u>
	F10.0	21-30	PXADJ - precipitation adjustment factor; applied to all precipitation
	7X,2A4	38-45	Identifier of rain plus melt time series; blank if not used
	1X,A4	47-50	Data type code of rain plus melt time series; blank if not used
	7X,2A4	58-65	Identifier of percent snowfall time series; blank if not used
	1X,A4	67-70	Data type code of percent snowfall time series; blank if not used
3	2X,2A4	3-10	Identifier of air temperature time series
	1X,A4	12-15	Data type code of air temperature time series
	3X,I2	19-20	Data time interval in hours of air temperature time series; must be a multiple of the data time interval of the precipitation time series; default is 6
	F10.0	21-30	Elevation associated with the air temperature time series in meters; default is elevation associated with temperature data is the same as the elevation of the area or point

Lapse rates only needed if the elevation of the temperature data differs from the elevation of the area or point where the model is being applied.

F5.0	31-35	Lapse rate at time of maximum temperature; assumed to occur at 3 PM Local Standard Time (units of DEGC/100M)
F5.0	36-40	Lapse rate at time of minimum temperature; assumed to occur at 6 AM Local Standard Time (units of DEGC/100M)

Card 3A only included if the rain-snow elevation indicator on card 1 is set to 'AVSE'.

3A	3X,I2	4-5	Number of points used to define the area-elevation curve (maximum is 12); does not include the maximum and minimum elevation points
----	-------	-----	---

<u>Card</u>	<u>Format</u>	<u>Columns</u>	<u>Contents</u>
	F10.0	6-15	Minimum elevation (units of FT or M)
	F10.0	16-25	Maximum elevation (units of FT or M)
	1X,A4	27-30	Elevation units for cards 3A and 3B: 'ENGL' = English units; default (units of FT) 'METR' = Metric units (units of M)
	2X,2A4	33-40	Identifier of the rain-snow elevation time series
	1X,A4	42-45	Data type code of rain-snow elevation time series

Card 3B included if the number of points used to define the area-elevation curve on card 3A is greater than zero. Card 3B can contain up to 4 points. Card 3B is repeated as necessary to input all points. Elevations must be in an increasing order.

3B	F10.0	1-10	Elevation of the 1st point on area-elevation curve (units of FT or M)
	2X,F3.2	13-15	Decimal fraction of area below the 1st elevation point
	F10.0,2X,F3.2	16-30	Second pair of elevation and fraction of area below points (if needed)
	F10.0,2X,F3.2	31-45	Third pair of points (if needed)
	F10.0,2X,F3.2	46-60	Fourth pair of points (if needed)

Card 4 only included if the observed time series indicator on Card 1 is set to 'YES'.

4	2X,2A4	3-10	Identifier of observed water-equivalent time series; blank if not used
	1X,A4	12-15	Data type code for observed water-equivalent time series; blank if not used
	3X,I2	19-20	Data time interval of observed water-equivalent time series; must be a multiple of the data time interval of the temperature time series; blank if not used
	2X,A3	23-25	Time series indicator for variance of observed water-equivalent; default is no variance time series; enter 'VAR'

<u>Card</u>	<u>Format</u>	<u>Columns</u>	<u>Contents</u>
			if variance of observed water-equivalent time series is used
	12,2A4	33-40	Identifier of observed areal extent of snow cover time series; blank if not used
	1X,A4	42-45	Data type code of observed areal snow cover time series; blank if not used
	3X,I2	49-50	Data time interval of observed areal snow cover time series; must be a multiple of the time interval of the temperature time series; blank if not used

Card 4A only included if the variance of observed water-equivalent time series indicator on Card 4 is set to 'VAR'. Time interval is assumed to be the same as the observed water-equivalent time interval.

4A	2X,2A4	3-10	Identifier of variance of observed water-equivalent time series
	1X,A4	12-15	Data type code of variance of observed water-equivalent time series

Card 5 only included if the simulated time series indicator on Card 1 is set to 'YES'.

5	2X,2A4	3-10	Identifier of simulated water-equivalent time series; blank if not used
	1X,A4	12-15	Data type code of simulated water-equivalent time series
	3X,I2	19-20	Data time interval of simulated water-equivalent time series; must be a multiple of the time interval of the temperature time series; blank if not used
	2X,A3	23-25	Time series indicator for variance of simulated water-equivalent' default is no variance time series; enter 'VAR' if variance of simulated water-equivalent time series is used
	12X,2A4	33-40	Identifier of simulated areal extent of snow cover time series; blank if not used
	1X,A4	42-45	Data type code of simulated areal snow

<u>Card</u>	<u>Format</u>	<u>Columns</u>	<u>Contents</u>
			cover time series; blank if not used
	3X,I2	49-50	Time interval of simulated areal snow cover time series; must be a multiple of the time interval of the temperature time series; blank if not used

Card 5A only included if the variance of simulated water-equivalent time series indicator on Card 5 is set to 'VAR'. Time interval is assumed to be the same as the time interval for the observed water-equivalent.

5A	2X,2A4	3-10	Identifier of variance of simulated water-equivalent time series
	1X,A4	12-15	Data type code of variance of simulated water-equivalent time series

Card 6 contains the major parameters for the snow model.

6	F5.0	1-5	SCF (snowfall correction factor)
	F5.0	6-10	MFMAX (maximum nonrain melt factor - units of MM/DEGC/6HR)
	F5.0	11-15	MFMIN (minimum nonrain melt factor - units of MM/DEGC/6HR)
	F5.0	16-20	UADJ (average value of the wind function during rain-on-snow events - units of MM/MB)
	F5.0	21-25	SI (areal water-equivalent above which there is always 100 percent snow cover - units of MM)
	4X,I1	30	Seasonal melt-factor variation indicator: 0 = use normal seasonal melt-factor variation (curve used is based on latitude) 1 = use user specified seasonal melt-factor variation

Card 6A is only needed if column 30, card 6 equals 1.

6A	12F5.0	1-60	User-specified seasonal melt-factor variation (specified as decimal fraction of where the melt-factor lies between MFMIN and MFMAX on the 16th of each month - i.e., 0.0 = MFMIN, 1.0 = MFMAX, 0.5 = ((MFMIN + MFMAX)*0.5). This option is primarily intended for
----	--------	------	---

Card	Format	Columns	Contents
------	--------	---------	----------

use in calculating melt from glaciers.

Card 7 contains minor parameters for the snow model and updating parameters.

7	F5.0	1-5	NMF (maximum negative melt factor - units of MM/DEGC/6HR)
	F5.0	6-10	TIPM (antecedent snow temperature index parameter - range is 0.1 to 1.0)
	F5.0	11-15	MBASE (base temperature for non-rain melt factor - units of DEGC)
	F5.0	16-20	PXTEMP (temperature that separates rain from snow; units of DEGC; rain if temperature is greater than PXTEMP, snow if less than or equal; not used if a valid percent snowfall time series value is available or if rain-snow elevation option is selected)
	F5.0	21-25	PLWHC (maximum amount of liquid-water held against gravity drainage - units of decimal fraction)
	F5.0	26-30	DAYGM (daily melt at the snow-soil interface; units of MM)

Next 2 values always needed for Operational Forecast System programs. Only needed for calibration if the update indicator on Card 1 is turned on.

	F5.0	31-35	Tolerance used when updating water-equivalent-decimal fraction; updating only occurs if Simulated-Observed is greater than tolerance times Observed (not used with Kalman Filtering updating)
	F5.0	36-40	Tolerance used when updating areal extent of snow cover - units of decimal fraction; updating only occurs if Simulated-Observed is greater than the tolerance
8	9F5.0	1-45	Areal depletion curve - decimal fraction; areal snow cover at WE/Ai ratios of 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9; for WE/Ai = 0.0, areal cover = 0.05; for WE/Ai = 1.0, areal cover = 1.0

Cards 9 through 11 are needed only if Kalman filtering updating

Card	Format	Columns	Contents
------	--------	---------	----------

indicator on Card 1 is set to 'PROP'. Card 9 contains the input error covariance matrix diagonals, RSNWELEV Operation identifier, a snow cover updating option indicator and printer output control for the state error covariance matrix (P).

9	F8.0	1-8	MAP error coefficient of variation
	F8.0	9-16	MAT error variance (units of DEGC squared)
	1X,2A4	18-25	Operation identifier to obtain lapse rate information; if the field is left blank then a default lapse rate of 0.0055 DEGC/M will be assumed; this parameter is needed only if Rain-Snow elevation indicator is set to 'AVSE' and Kalman filtering updating indicator is set to 'PROP' in card 1
	1X,A4	27-30	Indicator whether or not the areal extent of cover will be replaced with the value computed by the filter when updating occurs with observations of water-equivalent; default is to adjust snow cover outside the filter; enter 'SCKF' to replace snow cover with the value computed by the filter
	1X,A4	32-35	Printer output control for state error covariance matrix (P); default is 'NONE'; enter 'DIAG' to print diagonal elements, 'FULL' to print the full P matrix or 'MNTN' to print the full P matrix only on the first day of the month; daily values are printed according to IPRINT (card 1)

Card 10 contains the system error covariance matrix. Card 10 is repeated five times to input a symmetric (5 x 5) matrix. The diagonal and values to the lower-left of the diagonal are used. Thus 1 value is required on the first card, 2 values on the second and so on.

10	5F8.0	1-40	System error covariance matrix values; the order of rows/columns is: <ol style="list-style-type: none"> 1. WE (units of MM squared) 2. NEGHS (units of MMe squared) 3. LIQW (units of MM squared) 4. TINDEK (units of DEGC squared) 5. AESC (units of decimal fraction squared) This system error will be added each precipitation time interval
----	-------	------	---

Card	Format	Columns	Contents
------	--------	---------	----------

Card 11 contains default monthly variance of observed water-equivalent values. Default values are used whenever the variance is not specified with an observed water-equivalent value. Card 11 is repeated twice to input 12 monthly values.

11	6F8.0	1-48	Monthly default variance of observed water-equivalent (units of MM squared); -99. if not defined
----	-------	------	--

Card 12 only needed if read carryover indicator on card 1 is set to 'RDCO'

12	F5.0	1-5	Initial water-equivalent of solid (ice) portion of the snow cover (units of MM)
	F5.0	6-10	Initial heat deficit (units of MM)
	F5.0	11-15	Initial amount of liquid-water held against gravity drainage (units of MM)
	F5.0	16-20	TINDEX (initial antecedent snow temperature index - units of DEGC)
	F5.0	21-25	ACCMAX (maximum water-equivalent that has occurred since snow began to accumulate - units of MM)
	4X,I1	30	Read remaining carryover indicator; default is do not input remaining carryover values, instead calculate them based on card 9 values: 1 = read remaining carryover values
	F5.0	31-35	AESC (Areal extent of snow cover - units of MM squared)

Card 13 only needed if the indicator to read the remaining carryover values on card 9 is set to 1.

13	F5.0	1-5	SB (units of MM)
	F5.0	6-10	SBAESC (units of decimal fraction)
	F5.0	11-15	SBWS (units of MM)
	F5.0	16-20	STORGE (units of MM)
	F5.0	21-25	AEADJ (units of MM)
	7F5.0	26-60	Lagged excess water (units of MM); number of values is 5/timeint+2 where timeint is the precipitation data time interval

Card	Format	Columns	Contents
------	--------	---------	----------

Card 14 needed only if card 13 was read and Kalman filtering updating indicator on Card 1 is set to 'PROP'. Card 14 is repeated five times.

14	5F8.0	1-40	Initial state error covariance matrix (P) values; the order and units are the same as on card 10
----	-------	------	--

Sample Input and Output: Sample input is shown in Figure 1. Sample output from the parameter print routine is shown in Figure 2. Sample output from the execution routine is shown in Figure 3.

Error and Warning Messages: The error and warning messages generated by this Operation and the corrective action to take when they occur are as follows:

A. Messages that occur during setup.

1. ****ERROR**** TIME INTERVAL (XX HOURS) OF THE TEMPERATURE DATA IS NOT A MULTIPLE OF THE TIME INTERVAL (XX HOURS) OF THE PRECIPITATION.

Action: Change one or the other time interval so the time interval of the temperature data is a multiple of that for precipitation.

2. ****WARNING**** AT LEAST ONE OF THE LAPSE RATES ARE NOT POSITIVE. CHECK THAT VALUES ARE CORRECT.

Action: Temperature normally decreases with elevation, though in a few areas inversion conditions predominate, especially for minimum temperatures, during the snow season.

3. ****ERROR**** THE TIME INTERVAL OF A TIME SERIES (I.D.=XXXXXXXXX TYPE=XXXX XX HOURS) IS NOT A MULTIPLE OF THE TIME INTERVAL (XX HOURS) OF THE TEMPERATURE DATA.

Action: Change time intervals so the time interval is a multiple of that for the temperature data.

4. ****ERROR**** ONE OR MORE VALUES OF THE AREAL DEPLETION CURVE ARE LESS THAN THE PRECEDING VALUE.

Action: Make sure each value of the areal depletion is greater than or equal to the preceding value.

5. ****ERROR**** THE NUMBER OF AREA-ELEVATION CURVE POINTS INPUT (XX) EXCEEDS 12.

Action: Reduce the number of points used to define the area-elevation curve.

6. ****ERROR**** ONE OR MORE VALUES IN THE AREA-ELEVATION CURVE ARE LESS THAN THE PRECEDING VALUE.

Action: Make sure that the elevations and fraction of area below each elevation are in increasing order.

7. ****WARNING**** VAR FLAG IS SET IN CARD 4 BUT THE PROP FLAG IS NOT SET IN CARD 1. NO VALUES WILL BE READ FROM THE TIME SERIES.

Action: The variance time series information which is subsequently read from the following card will have no use in the model since the PROP indicator is not set and no updating will be done in the filter. Remove the VAR indicator to eliminate this warning.

8. ****WARNING**** VAR FLAG IS SET IN CARD 5 BUT THE PROP FLAG IS NOT SET IN CARD 1. NO VALUES WILL BE WRITTEN TO THE TIME SERIES.

Action: Because the model is not propagating the state error covariance matrix, no values will be available for the variance time series. Remove the VAR indicator to eliminate this warning.

B. Messages that occur during execution.

1. ****WARNING**** SNOW BALANCE RESIDUAL EXCEEDS 1 MM. RESIDUAL = XXXX.XX.

Action: Operation is not executing properly. Call your focal point.

Carryover Transfer Rules: The following adjustments are applied to carryover values when parameters are changed:

1. Liquid-water held against gravity drainage is reduced by the amount that it exceeds PLWHC multiplied by the ice portion of the snow cover.
2. SB and SBWS are decreased by the same amount that liquid-water is reduced.
3. SBAESC is recomputed if SI or the areal depletion curve are changed.
4. AESC is recomputed if SI or the areal depletion curve are changed or if liquid water is reduced.
5. Lagged excess water is redistributed if the time interval of the precipitation data is changed. If the time interval is decreased, some of the excess water is lost.
6. The state error covariance matrix is adjusted for any changes to model states that result from parameter changes.

All other carryover values are not affected by changes to parameters.

Punched Card Limitations: The punched card formats for this Operation are given as follows:

<u>Parameters or Variables</u>	<u>Punch Format</u>	<u>Maximum Value</u>	<u>Minimum Value</u>
PXADJ	F10.3	999999.999	0.001
Elevation of temperature data, elevations in area-elevation curve	F10.0	999999999.	-999999999.
Lapse rates	F5.2	99.99	-9.99
Elevation of area, SI, LIQW	F5.0	9999.	0.0 (Elev.=-999.)
Latitude, MBASE, PXTEMP, NEGHS, TINDEX, STORAGE, Lagged excess water	F5.1	999.9	0.0 (Temps=-99.9)
MFMAX, MFMIN, SCF, NMF, TIPM, DAYGM	F5.2	99.99	0.0
UADJ	F5.3	9.999	0.0
WE, ACCMAX, SB, SBWS, AEADJ	I5	99999	0
User specified seasonal melt-factor variation, depletion curve, AESC, SBAESC, PLWHC, updating tolerances	F5.2	1.00	0.0
Fraction of area below specified elevation	F3.2	.99	.01
MAP error coefficient of variation, MAT error variance, system error covariance matrix (Q), state error covariance matrix (P)	F8.<0-7>	9999999.	-999999.

Figure 1. Sample card input for Operation SNOW-43

```

- Column -
 5  10  15  20  25  30  35  40  45  50  55  60  65  70  75  80
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
SNOW-43      ANMWEUPR
ANIMAS ABOVE 3048 M 3385. 40.4      YES      UPDATE RDCO AVSE PROP
 6 ANMWEUPR MAP      1.000      ANMWEUPR RAIM
  ANMWEUPR MAT      6
  2      10000      14200 ENGL ANMCORWE RSEL
    12000 .75      13500 .98
  ANMWEUPR SWE      6 VAR      ANMWEUPR SASC      6
  ANMWEUPR VWES
1.10 1.00 0.200.100 600.      0
0.15 0.10 0.0 3.0 0.02 0.30 0.00 0.00
0.13 0.24 0.37 0.47 0.53 0.57 0.62 0.71 0.90
0.20      1.00      ANMWE
5.0
0.      0.01
0.      0.      0.01
0.      0.      0.      0.01
0.      0.      0.      0.      0.0001
-99.0 -99.0 -99.0 -99.0 -99.0 -99.0
-99.0 -99.0 -99.0 -99.0 -99.0 -99.0
 909 18. 0. -3.9 909 0

```

Figure 2. Sample output from Operation SNOW-43 Print parameter routine

```

*****
SNOW-43 OPERATION      NAME=ANMWEUPR      PREVIOUS NAME=
*****

SNOW MODEL OPERATION FOR ANIMAS ABOVE 3048 M      ELEV=3385. M      LAT.= 40.4

COMPUTATIONAL TIME INTERVAL IS 6 HOURS.

TIME SERIES USED BY THIS OPERATION.

CONTENTS              I.D.          TYPE          TIME INTERVAL    OTHER
PRECIPITATION         ANMWEUPR      MAP           6 HOURS          PXADJ= 1.00
AIR TEMPERATURE       ANMWEUPR      MAT           6 HOURS          TAELEV=3385.
RAIN+MELT             ANMWEUPR      RAIM          6 HOURS
SIMULATED W.E.        ANMWEUPR      SWE           6 HOURS
VARIANCE OF SIM. W.E. ANMWEUPR      VWES          6 HOURS
SIM. AREAL COVER      ANMWEUPR      SASC          6 HOURS
RAIN-SNOW ELEVATION   ANMCORWE      RSEL          6 HOURS

SNOW COVER VARIABLES DISPLAYED ON ALL SIGNIFICANT DAYS.

PARAMETER VALUES

MAJOR PARAMETERS      SCF  MFMAX  MFMIN  UADJ   SI
1.10  1.00  0.20  0.100  600.

MINOR PARAMETERS      NMF  TIPM  MBASE  PXTEMP  PLWHC  DAYGM
0.15  0.10  0.0    3.0    0.02  0.30

DEPLETION CURVE      WE/AI      0.0  0.1  0.2  0.3  0.4  0.5  0.6  0.7  0.8  0.9  1.0
COVER                0.05  0.13  0.24  0.37  0.47  0.53  0.57  0.62  0.71  0.90  1.0

AREA-ELEVATION CURVE      ELEVATION UNITS=FT

ELEV. 10000. 12000. 13500. 14200.
BELOW 0.00  0.75  0.98  1.00

KALMAN FILTERING UPDATING PARAMETERS
INPUT ERROR COV. MATRIX

MAP (Cv)              0.20
MAT (VAR)             1.00

USING LAPSE RATE OF 0.005500 DEGC/M - FROM RSNWELEV OPERATION ANMWE
SYSTEM ERROR COVARIANCE MATRIX FOR STATES:
WE, NEGHS, LIQW, TINDEXT AND AESC
5.00      0.      0.      0.      0.
0.      0.0100  0.      0.      0.
0.      0.      0.0100  0.      0.
0.      0.      0.      0.0100  0.
0.      0.      0.      0.      0.000100

DEFAULT MONTHLY OBSERVED W.E. VARIANCE,
JAN      FEB      MAR      APR      MAY      JUN      JUL      AUG      SEP      OCT      NOV      DEC
-99.     -99.     -99.     -99.     -99.     -99.     -99.     -99.     -99.     -99.     -99.     -99.

UPDATING PARAMETERS      TOLERANCES
W.E. COVER
0.00  0.00

SNOW COVER CONDITIONS FOR ANIMAS ABOVE 3048 M

WE  NEGHS  LIQW  TINDEXT  ACCMAX  AESC
909.  18.0  0.0  -3.9  909.  1.00

```

Figure 3. Sample Output from Operation SNOW-43 execution routine

'ANWWEUPR' SNOW-43 OUTPUT FOR ANIMAS ABOVE 3048 M											
DAILY OUTPUT IS FOR HOUR 5 TIME ZONE=MST											
3/1993											
(UNITS ARE 'IN' EXCEPT FOR AREAL COVER AND PCT. LIQ. WATER)											
DAY	SNOWFALL	RAIN	ENERGY EXCHANGE	SIM. AREAL COVER	PCT. LIQ. WATER	HEAT DEFICIT	SIM. WE	SIM. WE VARIANCE	OBS. WE	OBS. WE VARIANCE	RAIN-SNOW ELEVATION
30	0.0	0.0	-0.3	1.00	0.0	1.0	36.	0.	0.	0.	
31	0.0	0.0	-0.1	1.00	0.0	1.1	36.	0.	0.	0.	
1	0.0	0.0	0.0	1.00	0.0	1.1	36.	0.	0.	0.	1807.
2	0.6	0.0	0.0	1.00	0.0	1.1	36.	0.	0.	0.	
3	0.0	0.0	0.1	1.00	0.0	1.0	36.	0.	0.	0.	
4	0.0	0.0	0.1	1.00	0.0	0.9	36.	0.	0.	0.	
5	0.0	0.0	0.1	1.00	0.0	0.8	36.	0.	0.	0.	
6	0.0	0.0	0.1	1.00	0.0	0.7	36.	0.	0.	0.	

'ANWWEUPR' SNOW-43 OUTPUT FOR ANIMAS BELOW 3048 M											
DAILY OUTPUT IS FOR HOUR 5 TIME ZONE=MST											
3/1993											
(UNITS ARE 'IN' EXCEPT FOR AREAL COVER AND PCT. LIQ. WATER)											
DAY	SNOWFALL	RAIN	ENERGY EXCHANGE	SIM. AREAL COVER	PCT. LIQ. WATER	HEAT DEFICIT	SIM. WE	SIM. WE VARIANCE	OBS. WE	OBS. WE VARIANCE	RAIN-SNOW ELEVATION
30	0.0	0.0	-0.1	1.00	3.0	0.6	13.	0.	0.	0.	
31	0.0	0.0	0.0	1.00	3.0	0.6	13.	0.	0.	0.	
1	0.8	0.0	0.0	1.00	2.8	0.6	14.	0.	0.	0.	1016.
2	0.4	0.0	0.0	1.00	2.7	0.6	14.	0.	0.	0.	1807.
3	0.0	0.0	0.2	1.00	2.7	0.3	14.	0.	0.	0.	
4	0.0	0.0	0.5	1.00	3.7	0.0	14.	0.	0.	0.	
5	0.0	0.0	0.6	1.00	5.0	0.0	14.	0.	0.	0.	
6	0.0	0.0	0.6	1.00	5.0	0.0	14.	0.	0.	0.	